Coast 2050 Region 1

BAYOU SAUVAGE HYDROLOGIC RESTORATION (PO-16)
PO-16-MSPR-0598-3
PROGRESS REPORT No. 3
for the period
May 1, 1996 to May 4, 1998

Project Status

The following data collection and analysis activities have been conducted since the previous progress report.

Weekly staff gauge readings were collected from three stations in the North Unit, two stations in the South Unit and two stations in the reference area from February 20, 1997 through March 2, 1998. All staff gauges were surveyed to the North American Vertical Datum 1988 (NAVD) by National Wetland Research Center (NWRC) personnel in February 1997.

Water quality variables were collected at one continuous recorder site in the North Unit of the project area (PO16-01) from April 1, 1997 through March 19, 1998; one site in the South Unit of the project area (PO16-04) from June 10, 1997 through March 19, 1998; and at one site in the reference area (PO16-12R) from April 1, 1997 through March 19, 1998 (figures 1 and 2).

Marsh elevations (NAVD) have been established for the North and South Unit of the project area and the reference area. Elevations for the South Unit were obtained by using the staff gauge at station PO16-04 to survey the limited remaining patches of marsh in that vicinity. However, marsh elevations were not obtained for the areas around stations PO16-03 and PO16-05 due to the absence of any emergent marsh in these locations.

Project Description

The Bayou Sauvage Hydrologic Restoration (PO-16) project is located in the 23,820 ac (9,642 ha) Bayou Sauvage National Wildlife Refuge (NWR), 16 mi (26 km) east of New Orleans in Orleans Parish (figure 3). The 3,800 ac (1,538 ha) project area is bounded by U.S. Highway 90 to the north, the Lake Pontchartrain Hurricane Protection Levee to the east and south, and the Maxent Canal levee to the west. The Lake Pontchartrain Hurricane Protection Levee, built in 1956, hydrologically isolates the project area from the surrounding estuary, thereby creating a large impoundment with water depths ranging from 1 to 2 ft (0.3-0.6 m) (U.S. Fish and Wildlife Service [USFWS] 1994). The construction of these levees reduced natural tidal flow, leaving precipitation as the major source of water input for the area. The PO-16 project area is divided into two units (North Unit and South Unit) that are separated hydrologically by a railroad embankment (figure 1). The reference area is part of the Bayou Sauvage NWR and is located north of the project area adjacent to Lake Pontchartrain within the Hurricane Protection Levee system (figure 3).

Following the construction of the Hurricane Protection Levee, the Maxent Canal Levee was breached, and the South Unit was drained for an extensive time period, causing sediment oxidation, subsidence, and compaction that lead to accelerated marsh loss. The North Unit was not exposed

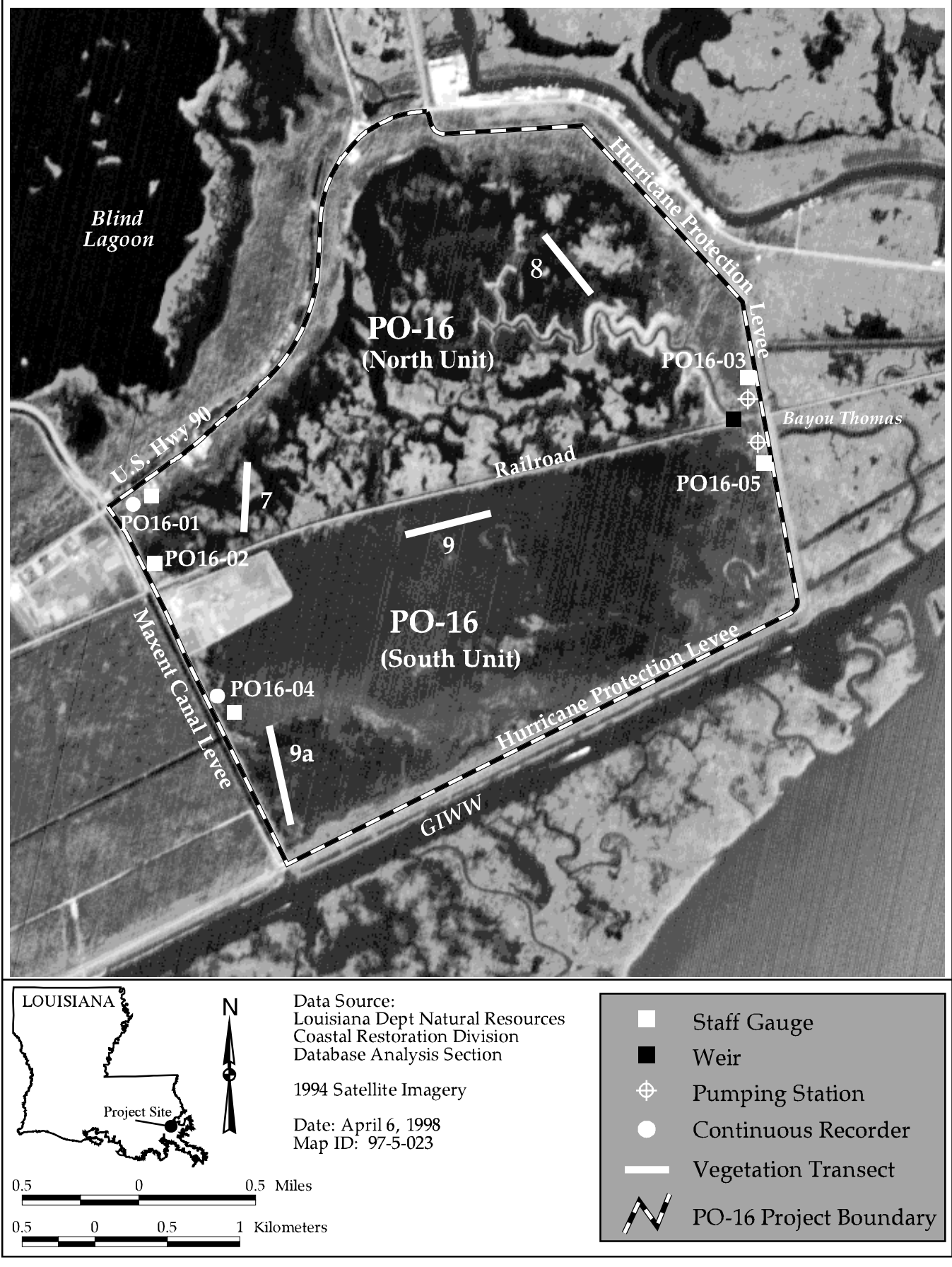


Figure 1. Project boundary and features for Bayou Sauvage Hydrologic Restoration (PO-16) project.

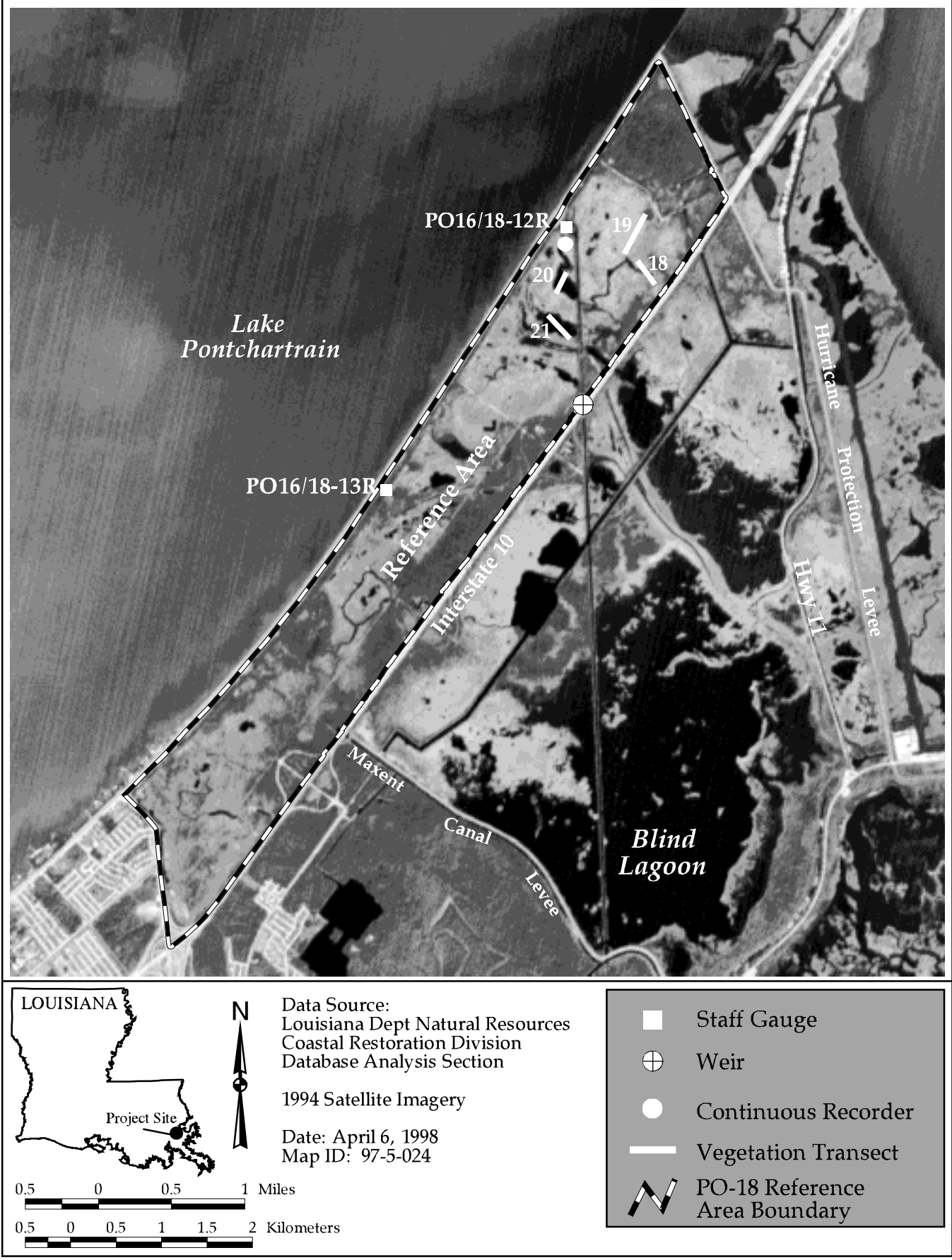


Figure 2. Reference area boundary and features for Bayou Sauvage Hydrologic Restoration (PO-16) project.

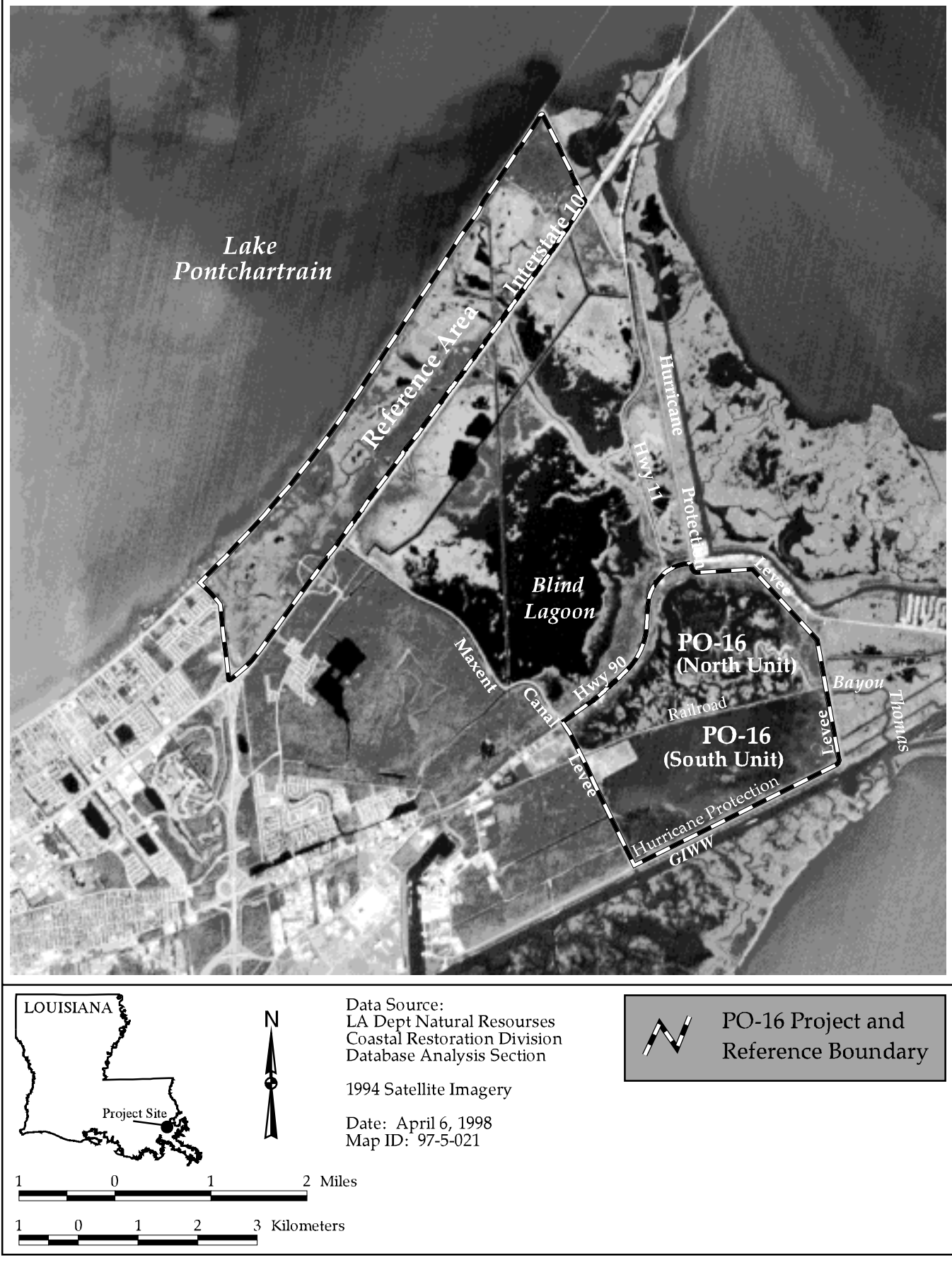


Figure 3. Project and reference area boundaries for the Bayou Sauvage Hydrologic Restoration (PO-16) project

to this drainage, and therefore experienced more gradual marsh loss (USFWS 1991). Approximately 117 ac/yr (47 ha/yr) of marsh habitat were lost from 1956 to 1978 throughout the entire refuge (USFWS 1994). Within the project area units, land loss was 81 ac/yr (32 ha/yr) (69% of the total land loss), resulting primarily from the processes described above (USFWS 1994).

The project area is classified as impounded fresh marsh (USFWS 1991). The dominant species include *Spartina patens* (marshhay cordgrass), *Alternanthera philoxeroides* (alligatorweed), *Ludwigia leptocarpa* (anglestem water primrose), and *Panicum spp.* (USFWS 1991). The reference area is classified as fresh/intermediate marsh (USFWS 1991), which is dominated by *S. patens* and *Ipomoea sagittata* (saltmarsh morningglory*)*.

The objective of this project is to enhance emergent fresh marsh habitats in the project area. The project-specific goals are to (1) promote the reestablishment of emergent marsh vegetation; (2) lower water levels to within the range of 0 - $^{-}$0.5 ft below marsh elevation (ME) during the spring and summer, and to within 0 -$^{+}$0.5 ft above ME during the fall and winter; and (3) preserve *Salix nigra* (black willow) habitat in order to maintain wading bird rookeries.

To reach this objective, a 48-in (1.2-m) pump was installed in each unit (figure 1) to lower water levels during spring and summer. A weir was installed across a small trenasse on the south bank of Bayou Thomas to ensure that the units are hydrologically isolated when water levels in the north unit fall to the level of the weir. The pumps are operated by USFWS personnel (table 1).

Methods

Near-vertical, color-infrared aerial photography (1:18,000 scale) was obtained in November 1993 which represents preconstruction conditions. These data will be compared to future postconstruction flights to document changes in marsh loss rates over time.

Water levels were recorded at 1 staff gauge in the North Unit and 1 staff gauge in the South Unit weekly for 2 months and monthly for 4 months by USFWS personnel from March 1996 to August 1996. Water levels were recorded weekly at five staff gauges within the project area (three in the North Unit and two in the South Unit) (figure 1) and two locations within the reference area (figure 2) from February 1997 to March 1998. Continuous recorders were installed in June 1996 to collect data, because staff gauges were not installed at this time. Temperature, salinity, specific conductance, and water depth were recorded hourly from June 1996 to March 1998 at stations PO16–01 and PO16–12R. An additional station was added in the South Unit (PO16-04) in April 1997 and data were collected until March 1998.

Vegetation was monitored postconstruction in 1996 and 1997 in the project and reference areas to determine species composition, percent cover, and relative abundance. Sampling was conducted using a modified Braun-Blanquet method (Steyer et al. 1995). Vegetation transects were established from sites previously sampled by USFWS (Harris 1989) using the line-intercept method (Chabreck 1972; Fletcher 1983). These preconstruction data collected by USFWS in 1989 were compared to

Table 1. USFWS operations of the Bayou Sauvage Hydrologic Restoration (PO-16) pumps in the North and South Units.

	Operation	
Date	Pump 5 (North)	Pump 6 (South)
Spring/Summer 1996	25 days of operation	14 days of operation
Fall/Winter 1996-97	10 days of operation	5 days of operation
Spring/Summer 1997	19 days of operation	33 days of operation
Fall/Winter 1997-98	26 days of operation	34 days of operation

Spring/Summer = Mar. 21 - Sept. 23
Fall/Winter = Sept. 24 - Mar. 20

the data collected in 1996 and 1997 by the Louisiana Department of Natural Resources (LDNR). Four transects in the project area (two in the North Unit and two in the South Unit) (figure 1) and four transects in the reference area (figure 2) were chosen to intersect dominant habitat types found in the project and reference areas. These included fresh marsh, *S. patens* dominated marshes, *S. nigra* stands, and open-water. In order to incorporate the modified Braun-Blanquet method, each transect was divided equally into 10, 2-m^2 plots, 5 of which were randomly selected for sampling. This provided a total of 20 permanent plots in both the project area (10 plots for the North Unit and 10 plots for the South Unit) and the reference area. Analysis of variance (ANOVA) was used to test for temporal and spatial changes (and interaction) in vegetation in relation to water levels.

Results/Discussion

There was a reduction in water levels in both the North and South Units of the project area following the pump startup on April 15, 1996. Similarly, the water level in the reference area also dropped at this time (figure 4). Pumps were shut down on May 3, 1996, as specified in the Annual Water Management Plan for the refuge (Harris 1995), and water levels continued to decline in both the project and reference areas. The observed springtime drop in water levels probably reflects the lower than normal spring rainfall in Louisiana in 1996 (Louisiana Office of State Climatology [LOSC] 1996) rather than the pump operations for the project. The pump in the North Unit was restarted June 22, 1996, due to increasing water levels, and an overall reduction in water level was noted. The pump in the South Unit could not be operated again because of mechanical problems. During the time period following June 22, 1996, the South Unit (broken pump) and the reference area (no pump) showed an overall increase in water levels. The pump in the North Unit was turned off July 12, 1996. Continuous data were collected from July 1996 to January 1997; however, because staff gauge readings were not available, these data could not be converted to a datum. Therefore, these data were not included in the analysis.

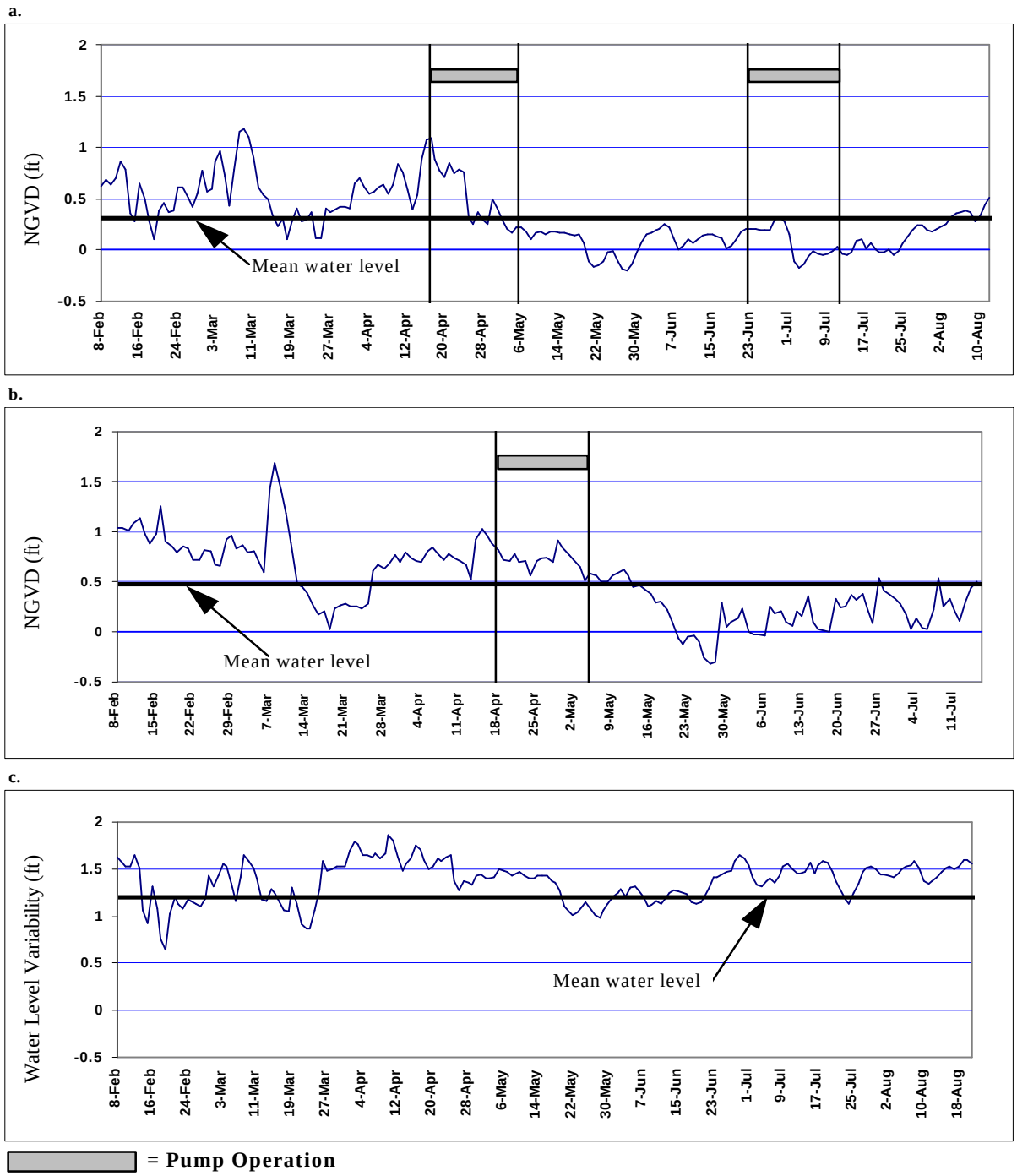


Figure 4: Water levels relative to NGVD for (a.) the north unit of the Bayou Savauge Phase I PO-16 project from daily means of continuous recorder data collected February 1996 to August 1996, and (b.) the south unit of the project from daily means of continuous recorder data collected February 1996 to July 1996. Water level variability (c.) for the reference area using daily means of continuous recorder data collected from February 1996 to August 1996.

The continuous recorders located at stations PO16-01 and PO16-12R were removed January 22, 1997, for servicing and conversion to a vented level sensor for depth measurements. Recorders were replaced at stations PO16-01 and PO16-12R, and initially placed at PO16-04 on April 1, 1997, and remained until March 19, 1998. Because the recorders were converted to a vented level sensor for atmospheric pressure correction and were also mounted differently than the previous recorders, these data cannot be compared to the previous data sets. Therefore, continuous data collected after April 1, 1997, will be compared only to staff gauge readings collected from April 1997 until March 1998 when the recorders were removed.

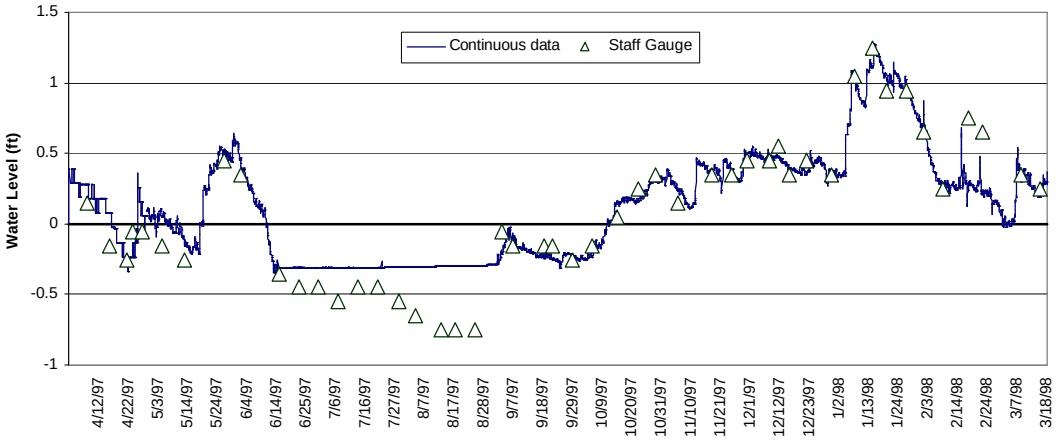
Comparison of the available data indicate that the staff gauge readings correspond with the continuous recorder data (figure 5). The only exception occurred at station PO16-01 in the North Unit during the time period from June 11, 1997, to September 6, 1997. During this time period, the continuous recorder depth probe was out of the water and unable to collect correct depth readings. Because the continuous data and staff gauge readings correlate, and because staff gauge data is now available weekly, there is no need to continue using of the continuous recorders. As a result, the continuous recorders were removed from the area in March 1998. Monitoring requirements as outlined in the monitoring plan are being met by the weekly staff gauge readings.

The effect of the project on water levels was evaluated through staff gauge readings in relation to marsh elevation. Staff gauge readings from the project area indicate that the goal to lower water levels to within the range of 0 - $^{-}$0.5 ft ME during the spring and summer was met 58 percent of the time for the North Unit and 8 percent of the time for the South Unit (table 2). Similarily, staff gauge readings indicated that the goal to keep water levels within 0 - $^{+}$0.5 ft ME during the fall and winter was met 55 percent of the time in the North Unit and 5 percent of the time in the South Unit. Although water levels for the South Unit do not fall within the target ranges for the majority of the time, the pumps did reduce water levels in the area during the spring and summer. All that remains of the marsh in the south unit are small patches of *Cladium jamaicense* (sawgrass) making it difficult to operate the pumps in relation to marsh elevation. Future increases in marsh to open- water ratio should yield greater correspondence to the target range. Water levels in the reference area fell within the spring/summer target 4 percent of the time and fell within the fall/winter target 65 percent of the time (table 2). The water level in the reference area did not exhibit a reduction for the spring and summer as did the project areas.

A regression analysis was conducted on the water level data from the north and south units of the project area, along with the reference area to determine a rate at which the pumping lowers water levels. Two time periods were selected for analysis; one during the summer and one during the winter. These specific dates were based on periods of pump operations at different times of the year. The analysis showed similar rates for summer and winter for both units of the project area (table 3). The reference area experienced a lower rate of decline than both of the project areas indicating that the pumps did effect drawdown.

For the winter analysis, a different time period was used to analyze the reference area due to the heavy rainfalls experienced during January. Throughout the state, especially the southeastern portion, heavy rainfalls produced a new state record making January 1998 the 2nd wettest January on

a.



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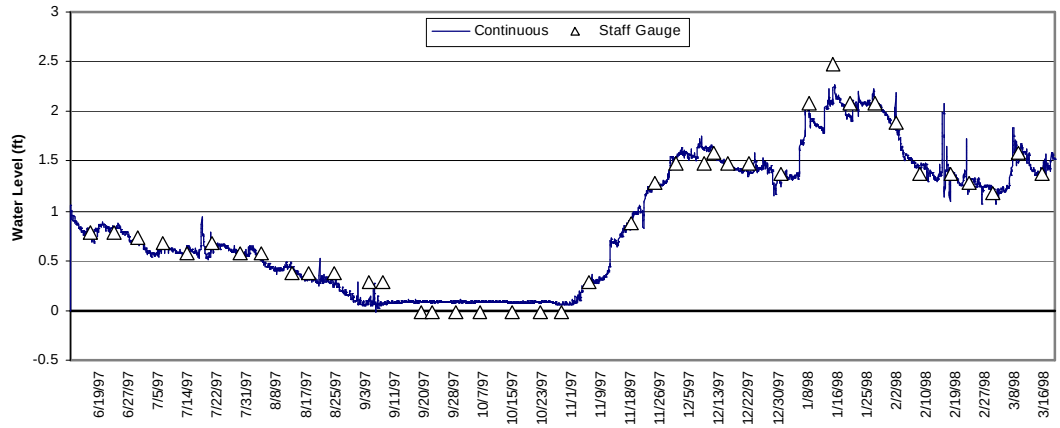

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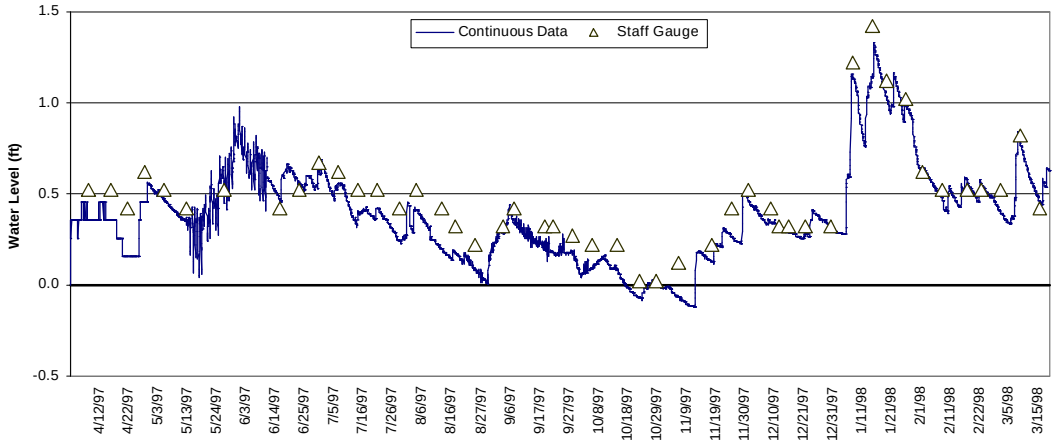

Figure 5. Comparison of continuous recorder water level data and staff gauge readings for the Bayou Sauvage Phase I (PO-16) a) North Unit, b) South Unit, and c) Reference Area. Water level range represents water levels in relation to marsh surface (0.0 ft).

Table 2. Percentage of time water level fell between indicated ranges for North and South Units of the project area and reference area. Ranges represent water levels in relation to marsh surface. Positive values indicate water over marsh surface. Negative values indicate water below marsh surface.

	North Unit		South Unit		Reference Area	
Season	Water Level	% time	Water Level	% time	Water Level	% time
Spring/ Summer	>2	0	>2	0	>2	0
	2 - 0.5	0	2 - 0.5	73	2 - 0.5	22
	0.5 - 0	19	0.5 - 0	19	0.5 - 0	74
	0 - -0.5	58	0 - -0.5	8	0 - -0.5	4
	-0.5 - -2	23	-0.5 - -2	0	-0.5 - -2	0
Fall/ Winter	>2	0	>2	68	>2	0
	2 - 0.5	36	2 - 0.5	5	2 - 0.5	28
	0.5 - 0	55	0.5 - 0	5	0.5 - 0	65
	0 - -0.5	9	0 - -0.5	23	0 - -0.5	7
	-0.5 - -2	0	-0.5 - -2	0	-0.5 - -2	0

Table 3. Rate of water level drop (ft/day) (SE) in the PO-16 project and reference areas during pump operations.

	Pump drawdown periods	
Stations	Summer	Winter
North Unit	-0.07 (0.007)	-0.06 (0.0011)
South Unit	-0.06 (0.003)	-0.04 (0.002)
Reference Area	-0.02 (0.005)	-0.01 (0.0001)

* Time periods: Summer=Jun.10-13;Winter=Jan.16-20 (except PO16-12R;Winter=Dec. 25-Jan. 4)

record (LOSC 1998). Because the reference area is separated from an adjacent project area (PO-18) by a weir which is set at 0.8 ft (0.24 m) NAVD (1.0 ft National Geodetic Vertical Datum), these areas become connected hydrologically during periods of heavy rainfall that produce high water levels. When these events caused water levels in the reference area to rise above 0.8 ft (0.24 m) NAVD (0.52 ft [0.16 m] over marsh surface), the drainage of the reference area is effected by the pumps in the adjacent project area. Regression analysis indicated a water level change of -0.06 ft/day in the reference area when the water levels were this high. This rate is equivalent to the water level reduction in the project areas due to pumping operation. Thus, this reference area may not be appropriate for comparison when water levels reach this magnitude. Subsequently, the period used for the analysis consisted of a period when water levels were less than 0.52 ft over marsh surface.

Comparison of the 1989 vegetation data collected by USFWS to the 1996 data set is difficult because it was not possible to relocate the exact sampling stations used in 1989. A cursory comparison of the 1989 and 1996 data sets indicate differences in dominant species only on transect 7. Most of that area was dominated by *Sacciolepis striata* (American cupscale*)* in 1989 with limited occurrences of *S. patens*. In 1996, however, *S. patens* dominated all three of the stations on transect 7 containing emergent vegetation. It is not known if the difference between the data sets resulted from differences in sample plot location (i.e., spatial variability in the plant community), or from differences over time in the plant community (i.e., temporal variability).

Vegetation data collected for the project area in 1996 showed dominant species in transect 7 (North Unit) to be *S. patens* and *Bacopa monnieri* (coast hyssop). The dominant species on transect 8 (North Unit) were *Panicum dichotomiflorum* (fall panic grass) and *B. monnieri*. Transect 9 (South Unit) ran across open-water and contained no emergent vegetation. Transect 9a (South Unit) exhibited lush, tall stands of *L. leptocarpa,* which was the most abundant species on this transect. The South Unit contains a greater percentage of open-water than the North Unit. In 1997, dominant species for the transects were similar however, *Cyperus oderatus* (flatsedge) was now present as a dominant species on transects 7, 8, and 9a. Transect 9 was open mud flats due to the drawdown.

Reference area transects 18 and 19, which ran across recently burned marsh, showed a dominance of *S. patens* and *I. sagittata* in 1996 and a dominance of *S. patens* in 1997. Transects 20 and 21 ran across open-water and contained no emergent vegetation in 1996 or 1997.

Comparison of species richness from the 1996 and 1997 data indicated that there was a difference between the north and south project areas, and the reference areas ($F_{2,20} = 6.19$, $P = 0.0081$). Post-ANOVA comparisons of least-square means indicated that richness declined in the reference area and northern project area from 1996 to 1997, but increased during that period in the southern project area (table 4).

The changes in the reference area over time are assumed to represent the natural trend during this period. The declining richness observed probably was associated with the drought of 1996 that increased richness in coastal marshes statewide (Weifenbach 1998). In the following year, richness began declining to typical numbers as flood sensitive annual plant species died back. Species richness data from this project indicate that the pumping was probably responsible for the large

Table 4. Mean species richness (SE) in1996 and 1997 in North and South Units of PO-16 project and reference area.

Area	1996	1997
North Unit	3.8 (0.2)	3.3 (0.2)
South Unit	1.4 (0.4)	3.4 (0.4)
Reference Area	3.5 (0.2)	2.8 (0.2)

increase in richness in the southern project area from 1996 to 1997. However, there was no evidence of a pump effect in the northern area on species richness. Although this is true for species richness, the presence of *C. oderatus* at both transects in the northern area gives an indication that the northern project area was subjected to periods of drying during the growing season (Chabreck and Condrey 1979).

Although a goal of the project is to maintain *S. nigra* habitat, there were too few observations of *S. nigra* to analyze that variable.

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Construction Start:	August 1, 1995	
Construction End:	May 1, 1996	